

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification: D21G 1/00, D21H 19/00		A1	(11) International Publication Number: WO 96/28609
			(43) International Publication Date: 19 September 1996 (19.09.96)
(21) International Application Number: PCT/SE96/00079		(81) Designated States: AL, AM, AU, BB, BG, BR, CA, CN, CZ, EE, FI, GE, HU, IS, JP, KG, KP, KR, LK, LR, LT, LV, MD, MG, MK, MN, MX, NO, NZ, PL, RO, SG, SI, SK, TR, TT, UA, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AZ, BY, KG, KZ, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 25 January 1996 (25.01.96)			
(30) Priority Data: 9500949-4 16 March 1995 (16.03.95) SE			
(71) Applicant (for all designated States except US): KORSNÄS AB [SE/SE]; S-801 81 Gävle (SE).		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(72) Inventors; and			
(75) Inventors/Applicants (for US only): ERIKSSON, Göran [SE/SE]; Herrgårdallen 4, S-804 26 Gävle (SE). KARLSSON, Klas-Erik [SE/SE]; Stabbläggargatan 2, S-804 30 Gävle (SE). LARSSON, Nils, Åke [SE/SE]; Nybergsallen 14, S-804 27 Gävle (SE). HÅKANSSON, Sven [SE/SE]; Ytterhamäsvägen 63, S-814 91 Furuviik (SE).			
(74) Agent: NILSSON, Brita; Oscar Grahn Patentbyrå AB, P.O. Box 19540, S-104 32 Stockholm (SE).			
(54) Title: COATED PAPERBOARD FOR FORMED ARTICLES			
(57) Abstract <p>Coated paperboard for formed articles, which paperboard consists of a fibermatrix in one, two or more layers and a coating and has adequate surface for printing and adequate surface gloss for each specific type of formed articles, is disclosed. The paperboard has been calendered after coating with a heatable calender having a soft extended nip, and has reduced density and reduced grammage at a given value for bending force compared to corresponding coated paperboard which has been calendered before or before and after coating with a heatable or non-heatable calender having a hard or soft nip. Additionally, a production line for the production of such coated paperboard, a process for the production of such coated paperboard, and a method of reducing the susceptibility to crack formation at folding of such a coated paperboard, are described.</p>			

2/11-28
3/17-25
1/8-18
3/11-11
3/30-52

1, 9, 3

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

COATED PAPERBOARD FOR FORMED ARTICLES

5 The present invention relates to coated paperboard for formed articles, e.g. liquid packaging board or white top liner, a process for the production thereof, a production line, and a method of reducing the susceptibility to crack formation at folding of a coated paperboard.

10 **Background of the invention**

For resource saving and improved economics it is advantageous to reduce the amount of raw materials needed for the production of a specific type of product. In a mill annually producing 200 000 tons of paper board for liquid packaging, a
15 reduction of the amount of raw materials needed for 1 litre packages by 1 % would make it possible to pack for example 70 million litres of milk products more per year without increasing the amount of raw materials used.
In Sweden this corresponds to the yearly consumption of milk in a city of the size of Gothenburg.

20 However, savings of raw material should desirably be achieved without having to compromise with the quality requirements of the product.

Important properties of coated paperboard for formed articles are sufficient stiffness
25 measured as bending force, good forming properties including low susceptibility to crack formation at folding, adequate surface for printing and adequate surface gloss. All of these required properties vary with the specific type of formed article which is to be produced from the coated paperboard.

30 A conventional way of producing board with high stiffness is to use a fibermatrix with three or more layers where the middle layer gives bulk and the two outer layers have a high elasticity modulus or high tensile stiffness. However, there are also coated board with high stiffness made from only two fiber layers.

In the production of coated paperboard it is known that the calendering operation together with the coating contributes to a good printing surface. However, at the same time the stiffness is to a certain extent reduced. In order to achieve an adequate surface for printing a calendering operation has been performed to reduce the surface roughness before the paperboard is subjected to a coating operation. Depending on the type of final product to be produced sometimes there is also performed a calendering operation after the coating operation to further improve the surface and increase the gloss to the desired level.

There are mainly two types of heatable or non-heatable calenders which are in use in paper mills today, namely hard nip calenders which have steel rolls, and soft nip calenders which have steel rolls where the counter rolls have a softer cover. The nip lengths in these soft nip calenders are typically approximately 1 cm.

A new type of calender is disclosed in Pulp & Paper International (PPI), May 1994, page 36. Surface properties of an uncoated board grade were reported to be improved with only minor loss of stiffness (bulk). The new calender is constructed to have a relatively soft elastic moving belt supported by a glide body or roll instead of the covered roll in a conventional soft calender. The elongated nip contour in combination with the soft elastic belt is reported to yield uniform specific pressures and nip lengths which typically would be four to six centimeter. This new type of calender has been named supersoft calender in said article, and said calender could be used in the present invention where a heatable calender with soft extended nip is required.

In the production of paperboard for formed articles the calendering operation has up to now been performed either before or both before and after the coating operation.

Description of the invention

It was surprisingly found that by deleting the conventionally used calendering operation before the coating operation and by performing a calendering operation

only after the coating operation with a calender which is run at high temperature and has a soft extended nip in the production of coated paperboard for formed articles, it was possible to obtain coated paperboard with reduced susceptibility to crack formation at folding and with adequate or improved surface for printing and adequate or improved surface gloss for specific types of formed articles and at the same time much increased stiffness. By reducing the thus obtained increased stiffness to values previously set for a certain type of product, it is now possible to significantly reduce the grammage and thus the amount of raw materials needed.

- 10 Savings in raw material can be made in the amount of fibermatrix used and/or the amount of coating used.

Thus, the present invention provides in one aspect a coated paperboard for formed articles, including liquid packaging board and white top liner, which paperboard consists of a fibermatrix in one, two or more layers and a coating and has adequate surface for printing and adequate surface gloss for each specific type of formed articles. The characteristic features of said paperboard are that it has been calendered after coating with a heatable calender having a soft extended nip, and has reduced density and reduced grammage at a given value for bending force compared to corresponding coated paperboard which has been calendered before or before and after coating with a heatable or non-heatable calender having a hard or soft nip.

The term "extended nip" is considered to comprise nip lengths of 3 to 10 cm, such as 4 to 8 cm, e.g. 6 to 7 cm.

The fibermatrix used in the present invention is preferably composed of sulphate pulp and/or mechanical pulp and/or recycled pulp, and is either unbleached or bleached. The coating of the board is composed of binders and usually also pigments to enhance the printability. Examples of common binders in this context are latex and starch, and examples of common pigments are clay and calcium carbonate.

The given value for bending force depends on the specific type of formed articles which are to be produced. Small formed articles or packages do not need as high values for bending force as larger ones. For example, for a coated liquid board from which smaller, such as 250 ml, packages are to be produced, values for bending force may be in the range of 50 to 100 mN, and for a coated liquid board from which larger, such as 1 liter, packages are to be produced values for bending force may be in the range of 200 to 300 mN.

10 Thus, in an embodiment of the invention there is provided coated paperboard for formed articles, wherein said given value for bending force is in the range of 20 to 300 mN, said reduction of density is in the range of 1 - 50 % and said reduction of grammage is in the range of 1 - 20%.

15 In another embodiment of the invention there is provided coated paperboard for formed articles, wherein said given value for bending force is in the range of 60 - 270 mN, said reduction of density is in the range of 1 to 35 % and said reduction in grammage is in the range of 1 - 15 %.

20 The percent reduction of the density and the percent reduction of the grammage of the coated paperboard at a given value for bending force are calculated on a corresponding coated paperboard for the same specific type of formed articles which has been calendered before or before and after coating with a heatable or non-heatable calender having a hard or soft nip.

25

In a preferred embodiment the fibermatrix of the coated paperboard of the invention is composed of two layers.

30 In another preferred embodiment of the coated paperboard of the invention the fibermatrix is composed of unbleached sulphate pulp in the bottom layer and bleached sulphate pulp in the top layer and the coating comprises binders and pigments.

In another aspect of the invention there is provided a production line for the production of coated paperboard, which paperboard consists of a fibermatrix in one, two or more layers and a coating and has adequate surface for printing and adequate surface gloss for each specific type of formed articles. The characteristic
5 feature of this new production line is that there is arranged, only after a coating device, a heatable calender with a soft extended nip.

Although a calendering operation with a heated calender having a soft extended nip is needed only after a coating operation for the production of coated paperboard for
10 formed articles which paperboard consists of a fibermatrix in one, two or more layers and a coating and has adequate surface for printing and adequate surface gloss for each specific type of formed articles, the present invention also comprises production lines where there is additionally arranged a calender before the coating device. There may be special circumstances when such precalendering would be
15 preferred, such as exceptionally high demands for surface properties. If a precalendering is performed then the savings of raw material will be less. The precalendering before the coating operation may be performed with any type of calender.

20 In yet another aspect of the invention there is provided a process for the production of coated paperboard for formed articles with adequate surface for printing and adequate surface gloss for each specific type of formed articles, wherein the fibermatrix of the paperboard is composed of one, two or more layers. The characteristic feature of the process is that a calendering operation is performed
25 only after a coating operation with a calender which is run at high temperature and has a soft extended nip.

In principal, the higher the temperature is, the better the surface properties of the coated paperboard will be. Typically the calender temperatures is in the range of
140 to 250 °C, but even higher temperatures are possible.

30 The present invention also comprises a process for the production of coated paperboard for formed articles wherein there is additionally performed a calendering operation before said coating operation.

In still another aspect of the invention there is provided a method of reducing the susceptibility to crack formation at folding of a coated paperboard with adequate surface for printing and adequate surface gloss for each specific type of formed articles, wherein the fibermatrix of the paperboard is composed of one, two or more layers. The characteristic feature of the method is that said coated paperboard is produced in a production line wherein a calendering operation is performed only after a coating operation with a calender which is run at high temperature and has a soft extended nip.

The present invention also comprises such a method, wherein there is additionally performed a calendering operation before said coating operation.

The following Examples will illustrate the different aspects of the invention.

In the examples a fibermatrix in two layers, a bottom layer of unbleached sulphate pulp and a top layer of bleached sulfate pulp, and a coating consisting of pigments and binders, were used.

The Print-surf roughness at 1000 kPa was measured according to ISO 8791-4:1992 (E).

The Gloss was measured according to Tappi, T 480.

The Density was measured according to SCAN P 7:75.

The Bending force was measured according to SCAN P 29:84.

The Uniformity variance was evaluated with the aid of an image analyzer "Kontron IBAS" system.

The grammage was measured in accordance with SCAN P6:75.

EXAMPLE 1

In a pilot trial it was shown that the uniformity of the coated surface was better when the calend ring aft r coating was done with an xtended soft nip in comparison with a conventional soft nip. The board was in this case calendered also before coating.

3-10 ?

It was also shown that the density was lower when using an soft extended nip in comparison with a conventional soft calender.

	Print-surf roughness μm	Gloss	Density, kg/m^3	Uniformity variance, %
Soft	3.23	38	685	0.74
nip	2.73	45	730	0.77
140°C	2.43	51	749	0.80
Extended	3.24	32	661	0.63
soft	3.06	39	680	0.62
nip	2.46	43	687	0.63
140°C				

- 5 The uniformity of the coating was measured in an image analyzer in the wave length area 2.0-8.0 mm.

EXAMPLE 2

- 10 In another pilot trial it was shown that taking advantage of the decreased density, th stiffness could be increased by using the soft extended nip calender after coating. The effect was greatest when no calendering was done before coating and the coat weight was reduced.

	Print-surf roughness μm	Gloss	Grammage g/m^2	Bending force mN	Density kg/m^3
Cbc + 21 g/m^2 coating	3.75	29	266	255	675
No Cbc + 21 g/m^2 coating + Cac with SEN	3.75	31	266	266	650
Cbc + 11 g/m^2 coating + Cac with SEN	3.75	27	266	267	660
No Cbc + 11 g/m^2 coating+ Cac with SEN	3.75	32	266	280	639

5

.....
Cbc = Calendering before coating
Cac = Calendering after coating
SEN = Soft Extended Nip

10

EXAMPLE 3

In a mill trial the soft extended nip calender was used to produce the same surface as the reference quality which was calendered only before coating. When the
5 extended nip calender was used the calendering was done only after coating.

	Grammage g/m ²	Gloss	Bending force, mN	Print-surf roughness μm	Density kg/m ³
Cbc + 22 g/m ² coating	255	17	228	3.9	651
No Cbc + 11 g/m ² coating + Cac with SEN	255	25	266	3.3	597

.....
Cbc = Calendering before coating

Cac = Calendering after coating

10 SEN = Soft Extended Nip

The stiffness increase measured as bending force was greater than in the pilot trials.

This increase in stiffness means that the grammage can be reduced from 255 g/m²
15 to 245 g/m² keeping the other specifications at the same or even improved levels.
This improvement makes it possible to further decrease the grammage.

Board from the mill trial was also tested against the susceptibility to crack formation at folding of a coated paper board.

20

The tendency of crack formation was measured by folding the board in a controlled manner according to a standardized method developed for this purpose and evaluating the crack tendency on a scale of 1 to 5 as follows:

- 5 0 = Perfect
 1 = Good
 2 = Tendency to crack
 3 = Small crack
 4 = Crack
 10 5 = Big crack

	Susceptibility to crack formation	
	top side	bottom side
Cbc + 22 g/m ² coating	3.2	3.0
No Cbc + 11 g/m ² coating + Cac with SEN	1.4	1.3

The board from the mill trial was also printed and the print result was evaluated. The overall print result and the uniformity of the print was better for the test quality.

15

	Uniformity	(image analyzer
	Variance %	0.35-5.6 mm)
Cbc + 22 g/m ² coating	9.54	
No Cbc + 11 g/m ² coating + Cac with SEN	8.15	

.....
 Cbc = Calculating before coating

Cac = Calculating after coating

SEN = Soft Extended Nip

28351/BN

Claims

5

1. Coated paperboard for formed articles, which paperboard consists of a fibermatrix in one, two or more layers and a coating and has adequate surface for printing and adequate surface gloss for each specific type of formed articles,

characterized in that said paperboard has been calendered after coating
10 with a heatable calender having a soft extended nip, and has reduced density and reduced grammage at a given value for bending force compared to corresponding coated paperboard which has been calendered before or before and after coating with a heatable or non-heatable calender having a hard or soft nip.

15 2. Coated paperboard according to claim 1, wherein said given value for bending force is in the range of 20 to 300 mN, said reduction of density is in the range of 1 - 50 % and said reduction of grammage is in the range of 1 - 20 %.

3. Coated paperboard according to claim 2, wherein said given value for bending
20 force is in the range of 60 - 270 mN, said reduction of density is in the range of 1 to 35 % and said reduction in grammage is in the range of 1 - 15 %.

4. Coated paperboard according to any one of the claims 1 - 3, wherein said paperboard is a white top liner.

25

5. Coated paperboard according to any one of the claims 1 - 3, wherein said paperboard is a liquid packaging board.

6. Coated paperboard according to any one of the claims 1 - 5, wherein said
30 fibermatrix is composed of two layers.

7. Coated paperboard according to claim 6, wherein said fibermatrix is composed of unbleached sulphate pulp in the bottom layer and bleached sulphate pulp in the top layer and said coating comprises binders and pigments.

8. Production line for the production of coated paperboard, which paperboard consists of a fibermatrix in one, two or more layers and a coating and has adequate surface for printing and adequate surface gloss for each specific type of formed articles characterized in that there is arranged, only after a coating device, a heatable calender with a soft extended nip.
9. Production line for the production of coated paperboard according to claim 8, where there is additionally arranged a calender before the coating device.
10. Process for the production of coated paperboard for formed articles with adequate surface for printing and adequate surface gloss for each specific type of formed articles, wherein the fibermatrix of the paperboard is composed of one, two or more layers, characterized in that a calendering operation is performed only after a coating operation with a calender which is run at high temperature and has a soft extended nip.
11. Process for the production of coated paperboard according to claim 10, wherein there is additionally performed a calendering operation before said coating operation.
12. Method of reducing the susceptibility to crack formation at folding of a coated paperboard with adequate surface for printing and adequate surface gloss for each specific type of formed articles, wherein the fibermatrix of the paperboard is composed of one, two or more layers, characterized in that said coated paperboard is produced in a production line wherein a calendering operation is performed only after a coating operation with a calender which is run at high temperature and has a soft extended nip.
13. Method of reducing the susceptibility to crack formation at folding of a coated paperboard according to claim 12, where in there is additionally performed a calendering operation before said coating operation.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96/00079

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21G 1/00, D21H 19/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21G, D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: ALLSCIENCE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
T	Dialog Information Services, File 148, Trade & Industry Database(TM), Dialog accession no. 08147347, Supplier Number 17379701, FERGUSON, KELLY H.: "High-end coated board market guides T-I's technology selection"; Pulp & Paper, v 69, n 9, p 63(5), Sep,1 995 -----	

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

& document member of the same patent family

Date of the actual completion of the international search

4 July 1996

Date of mailing of the international search report

05 -07- 1996

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Olov Jensen
Telephone No. +46 8 782 25 00

